

# What is Cost-Risk?

presented to  
NASA RISK MANAGEMENT CONFERENCE  
6 DEC 05

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# OUTLINE

- What is Cost-Risk?
- Common Definition
- Cost Estimator Definition
  - Assessment
    - Cost Estimating Relationship (CER) Risk
    - Cost Driving Parameter Risk
    - Key Engineering Parameter Performance (KEPP) Risk
    - Correlation Risk
  - Analysis
    - Convolution (e.g., analytic; monte carlo)

# Common Definition

- “The potential for final costs to exceed the target cost”
- ...something like that anyway

# Cost Estimator's Definition

- “Cost-risk is composed of five elements:
  - CER Risk
  - Input Parameter Risk
  - Key Engineering Parameter Performance (KEPP) Risk
  - Correlation Risk
  - Convolution of Distributions
- These type of risks are intended to be “known unknowns”

# Cost-Risk Assessment & Analysis

- Assessment

- 1. *Cost model risk***

- Cost estimators handle this

- 2. *Input parameter risk***

- Engineering assessment needed

- 3. *Key Engineering Parameter Performance (KEPP) risk***

- Engineering assessment needed
    - 3 WBS element risk profiles (pessimistic, optimistic & reference) evaluated in terms of cost-risk drivers

- 4. *Correlation risk***

- Engineering/cost estimator assessment needed

- Analysis

- Convolve all distributions for “S”-curve (CDF)

# Cost-Risk Assessment

## ***1. Cost model risk***

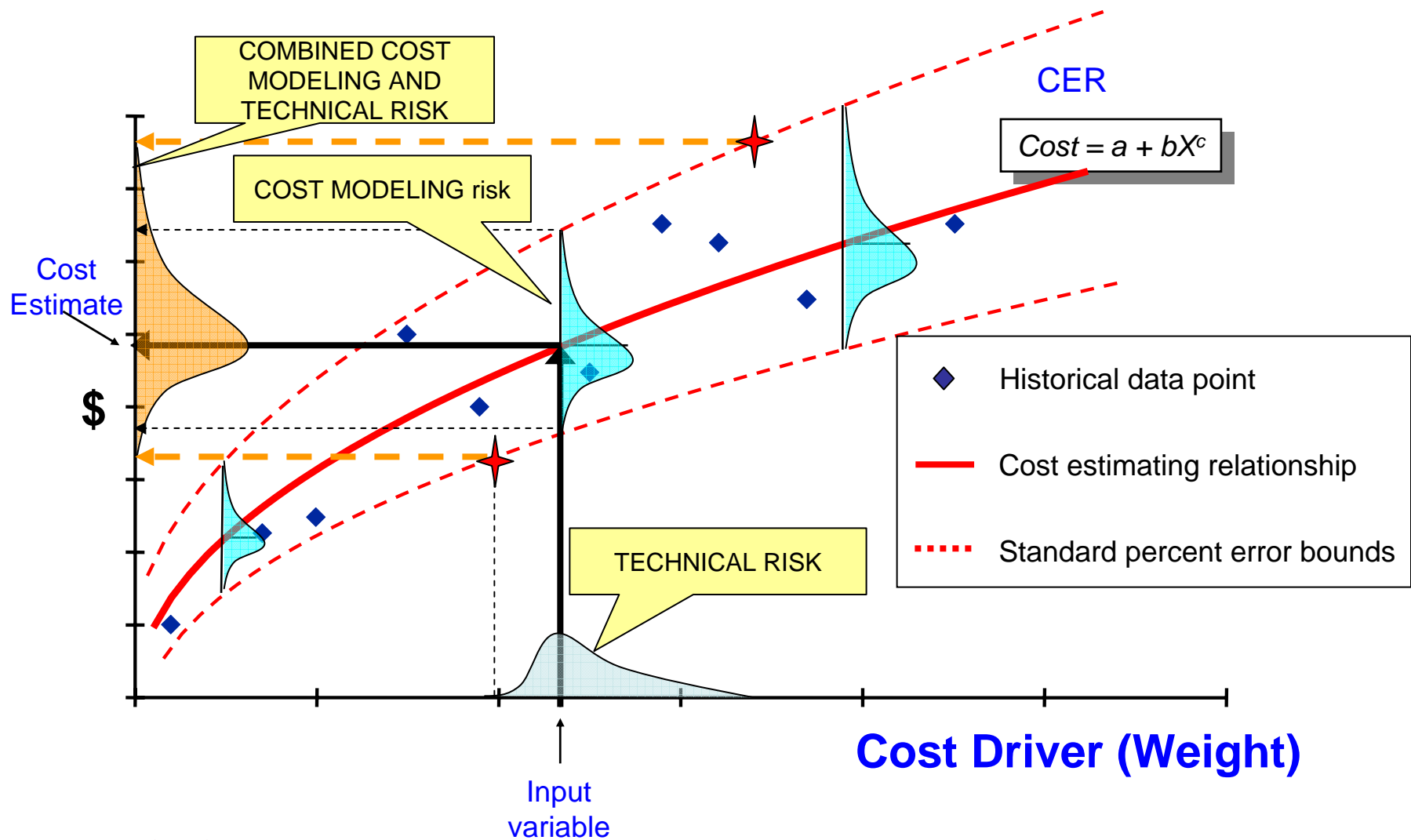
- Accomplished in ESAS FY 06-11 cost-risk

## ***2. Input parameter risk***

- Accomplished in ESAS FY 06-11 cost-risk

# Cost Model and Input Parameter Risk

## Cost Quantification



# Cost-Risk Assessment (cont)

## ***3. Key Engineering Parameter Performance (KEPP) risk***

- ***A Key Engineering Performance Parameter is a technical or operational parameter that can be described as a requirement***
- **Partially Accomplished in ESAS FY 06-11 cost-risk**
  - Adds cost-risk impacts due to TRL, Design/Engineering, Integration, Requirements Stability, Complexity, etc., risks
  - Relative Risk Weighting process & NAFCOM can capture these risks



# Key Engineering Performance Parameters<sup>1</sup> (KEPP) Examples

- KEPPs for new electronic component for a S/C
  - Dynamic load resistance
  - Operating voltage
  - Power regulation
  - Radiation resistance
  - Emissivity
  - Component mass
  - Operating temperature range
  - Operating efficiency
- KEPPs for a Laser/Amplifier Transmitter
  - Wave front sensing
  - Wave generation
  - Mirror coatings and gratings
  - Autonomous resonator alignment
  - Bore sighting
  - Electrical power generation

<sup>1</sup>*The Technology Puzzle:  
Quantitative Methods for Developing Advanced  
Aerospace Technology; Liam Sarsfield (RAND)*

# RRW Implemented in Excel

(Degree System's KEPPs Impacted by Cost-Risk Drivers in each Scenario)

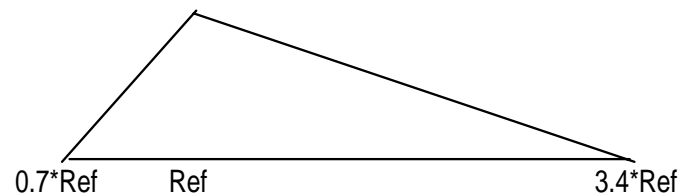
		COST-RISK DRIVERS					Risk Score
		TRL	Des/Eng	Schedule	Integration	Reqs Stab	
(Driver Weights) →		0.2	0.3	0.15	0.2	0.15	
WBS Scenarios	Pessimistic	0.048	0.111	0.058	0.049	0.080	0.345
	Reference	0.020	0.027	0.026	0.016	0.014	0.102
	Optimistic	0.014	0.023	0.007	0.016	0.011	0.071

		TRL	Des/Eng	Schedule	Integration	Reqs Stab	Ratio Scale Numbers from AHP
Intensities	Very High	0.397	0.370	0.385	0.442	0.534	
	High	0.240	0.220	0.262	0.243	0.216	
	Moderately High	0.139	0.150	0.171	0.142	0.094	
	Moderate	0.099	0.089	0.078	0.081	0.070	
	Moderately Low	0.070	0.075	0.049	0.047	0.044	
	Low	0.033	0.054	0.034	0.026	0.026	
	Very Low	0.022	0.042	0.021	0.019	0.016	

Pess/Reference  
Ratio: 3.4

Opt/Reference  
Ratio: 0.7



# Cost-Risk Assessment (cont)

## ***4. Correlation risk***

- Accomplished in ESAS

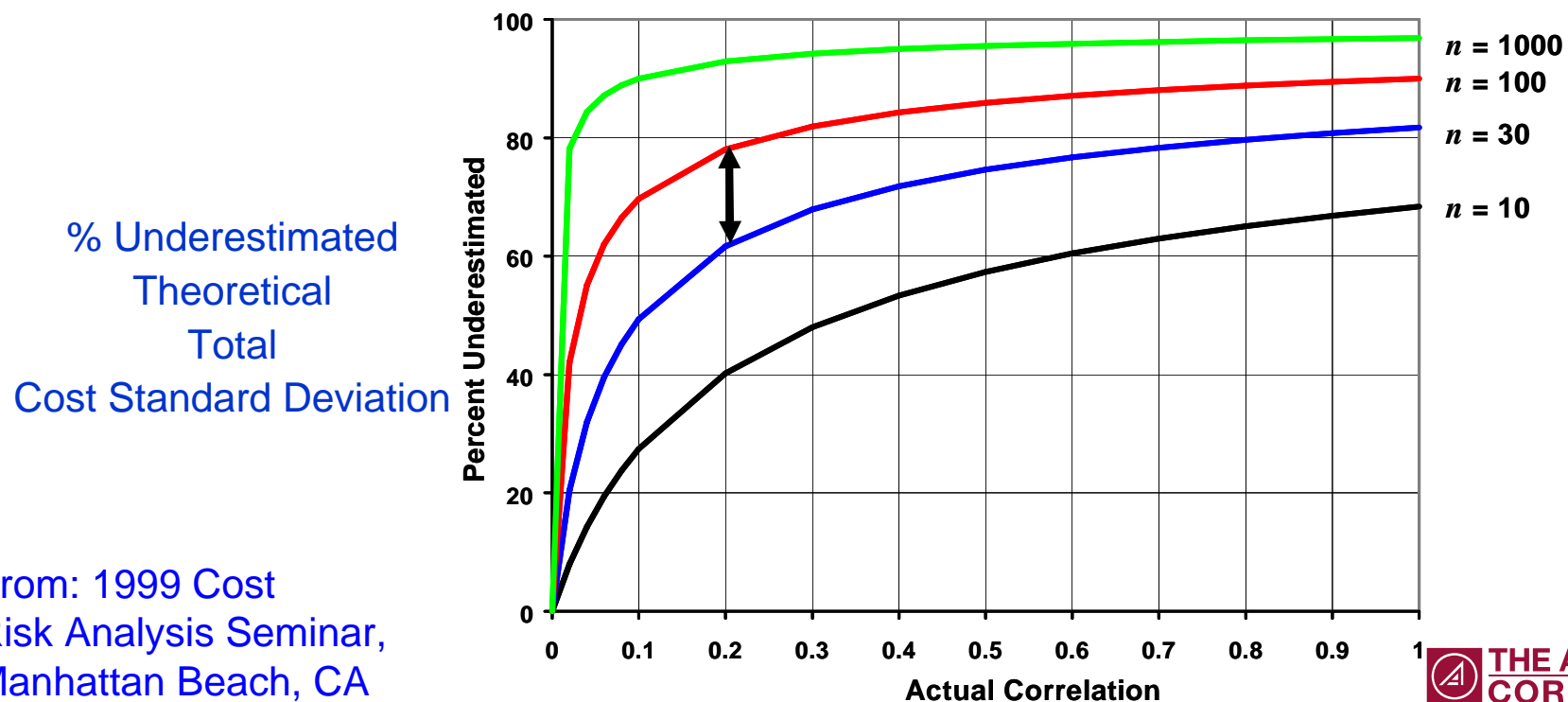
# CORRELATION

- What is Correlation?<sup>2</sup>
  - A measure of association between two variables
  - It measures how strongly the variables are related, or change, with each other
- Engineers and CRM specialists can assist cost estimators in identifying and quantifying correlation between WBS elements or systems

<sup>2</sup> [www.statlets.com/usermanual/glossary.htm](http://www.statlets.com/usermanual/glossary.htm)

# Correlation

- Dr. Stephen Book (MCR) plotted the theoretical underestimation of percent total cost standard deviation (y-axis) when correlation (x-axis) is assumed to be zero rather than its true value,  $\rho$ .
  - In cost estimates we would underestimate % SD ~60%-80% if we ignored correlation and it was actually 0.2

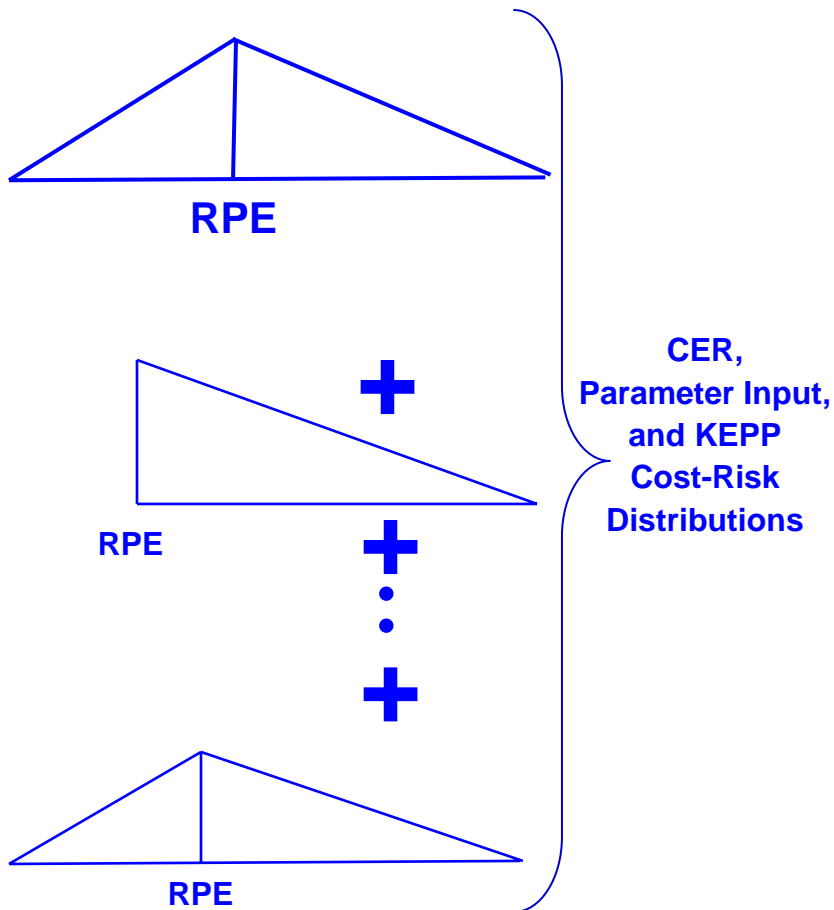


# Cost-Risk Analysis

- Analysis
  - Convolve all distributions for “S”-curve (CDF)

# Cost-Risk Analysis: Convolution

## CORRELATED SUBSYSTEM & SYSTEM COST DISTRIBUTIONS:



## SUMMARY COST DISTRIBUTIONS: BELL CURVE

